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(54) **CYLINDRICAL AIR FILTER WITH LIGHTWEIGHT HOUSING AND RADIALY DIRECTED SEAL**

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<b>BE-A- 545 333</b>	<b>DE-C- 671 029</b>
<b>FR-A- 1 100 273</b>	<b>FR-A- 1 131 647</b>
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<b>FR-A- 2 261 041</b>	<b>FR-A- 2 268 551</b>
<b>GB-A- 2 005 777</b>	<b>US-A- 4 135 899</b>
<b>US-A- 4 227 898</b>	<b>US-A- 4 491 460</b>

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## Description

### Background of the invention

This invention relates generally to air cleaners or filters and more particularly relates to air cleaners with cylindrical, pleated paper filter elements used primarily with over-the-road trucks and agricultural tractors. In such air cleaners, the air is drawn into a housing and radially inwardly through the filter element for axial discharge therefrom. The cylindrical air filter element is sealed within the housing so that all air entering the housing must pass through the walls of the filter element.

In the prior art, sealing of the filter element in the housing has been accomplished by compressing the outlet end of the filter element against the end wall of the housing, and by providing a gasket between the end of the filter element and the housing end wall. An example of this is shown in US-A-3,078,650 (Andersen et al) issued February 26, 1963, in which a yoke assembly cooperating with a threaded wing bolt and nut is used to compress the filter element against the end wall of the housing to prevent leakage of air around the filter element. Various other latches and clamping devices have been used to effect a positive clean air seal in such filter assemblies. Using such state of the art axial compression sealing techniques requires filter elements constructed so as not to collapse under compression, and requires the use of relatively heavy-gauge steel in the housing to withstand the pressures. Because both the filter housing and the filter element must be strong and rigid when using such techniques, improvements in the area of low-cost, lightweight elements and housings have been hampered. With respect to the housings, non-engineering grades of plastics as well as some moulding processes could not be safely utilized.

Similar considerations apply to air filter assemblies disclosed in FR-A-1131647 and BE-A-545333, wherein sealing means are provided on the upper axial end of the assembly. The sealing means being compressed between the upper end of the assembly and the upper wall of a housing enclosing the assembly has the disadvantages of requiring filter elements that do not collapse under compression, a sturdy housing, etc., already mentioned in relation to US-A-3,078,650.

In the prior art air filter assembly recited in the pre-characterising part of claim 1 and disclosed in GB-A-2005777, an outlet member is axially spaced from the filter assembly by an interconnecting and sealing end cap or gasket, designed to engage the upper end of the filter assembly and the outlet member in such a way as to prevent axial displacement. In order to provide an axial type seal as well

as a reliable interconnection the gasket has particularly-shaped grooves and the manufacturing requires relatively close tolerances to properly engage the outlet member.

### Summary of the invention

The present invention provides an air cleaner construction having the features recited in claim 1. In the filter arrangement according to the invention the positive clean air seal is established between the radially inwardly facing surface of the filter element end cap and the tubular air outlet member so that there is no need to compress the filter element as in the prior art to achieve a seal between the end of the filter element and the housing. In the preferred embodiment, this is accomplished by moulding the ring like end cap at the open end of the filter element of urethane foam material having a relatively soft, rubber like consistency, the cylindrical inner surface thereof being constructed and arranged to fit over and sealingly engage an inner end portion of a tubular air outlet member. A relatively lightweight housing can then be provided to channel the flow of air through the filter element. The housing can be dimensionally unstable because the housing does not have to support any clamping forces as in the prior art. No mechanical aids or clamps are necessary to exert outside force because the seal is self-generated when the end cap is inserted over the tubular outlet member, and the sealing forces are enhanced by the air pressure differential exerted on the filter element during operation thereof. As a result, the housing can be constructed from a relatively light plastic material or from a thinner metal. The structural requirements of the filter element are also reduced because it does not have to withstand mechanical compression.

The Gauer U. S. Patent No. 4,135,899, issued January 23, 1979, discloses a typical prior art clamping arrangement for holding both a primary filter and a safety filter in a cylindrical housing. The safety filter of the Gauer device has an annular resilient mounting member 133 with an internal groove adapted to engage a bead on the end of the air outlet tube. However, this connection is no relied upon or designed to provide a positive clean air seal. The axially outer end of member 133 has a flattened surface to sealingly engage the end wall of the housing. The radially extending lip 134 of member 133 is compressed against the end wall of the housing by means of a clamping arrangement similar to that heretofore described. Thus, the Gauer patent does not teach or suggest the desirability of utilizing a radially inwardly directed seal in order to eliminate the clamping device.

The present invention provides the designer with a variety of inherent lightweight design options having a performance equivalent to air cleaners designed according to the state of the art. The design is compatible to non-metallic I.E. commodity (non-engineering grade) plastic housings with large expansion/contraction ratios. The lightweight plastic housing and element have good vibration dampening/absorption characteristics, further enhancing minimal housing structure requirements. Another advantage is that the gasket is located inside of the filter element so that it is protected during shipping and handling.

#### Brief Description of the Drawings

FIGURE 1 is a view in side elevation of an air cleaner according to the invention, portions thereof being broken away and portions being shown in section;

FIGURE 2 is a view in perspective of a filter element according to the invention, with portions of the housing being shown schematically in broken lines; and

FIGURE 3 is an enlarged fragmentary portion of the outlet area showing the tubular outlet member removed from the resilient end cap.

#### Description of the Preferred Embodiment

Referring now to the drawings, wherein like reference numerals are used throughout the several views to indicate like elements of the invention, there is disclosed in FIG. 1 an air cleaner or filter having a housing 10 with a generally cylindrical outer wall 10a, a first generally closed end 10b comprising a generally circular end wall having an axial outlet opening 10c, and a generally open second end having a circular outwardly extending flange 10d to which is connected a removable cover 11 by means of a plurality of threaded bolts 12a and plastic nuts 12b. Housing 10 is cylindrical with respect to a longitudinal axis 13. Formed in the outer wall 10a is a peripheral air inlet opening 14.

A generally tubular or cylindrical filter element 15 is carried within housing 10 coaxial therewith. Filter element 15 has an inner liner 15a and an outer liner 15b, both being cylindrical, and both being constructed from perforated metal. A cylindrical pleated paper filter 16 is mounted between the inner liner 15a and the outer liner 15b. Filter element 15 has a closed end 17 in the form of a circular cap of a urethane foam material molded thereon and having a relatively soft, rubber-like consistency. Cap 17 is molded over and holds together the ends of liners 15a, 15b and filter 16 and extends across that end of the filter element 15

to provide a closed end. Cap 17 has a plurality of protrusions 17a extending axially outwardly therefrom for contact with the cover 11. The diameter of housing 10 around cap 17 is about the same as the outside diameter of the cap 17 to hold filter element 15 centered within the housing.

Closed end wall 10b is provided with an axially outwardly extending tubular portion 10e around axial air outlet opening 10c. A generally cylindrical outlet member 20 is mounted in outlet opening 10c having an outer smaller diameter portion 20a and an inner larger diameter portion 20b connected by a planar ring portion 20c. The axially outer end of outer portion 20a is formed to be of slightly larger diameter to provide a wide groove between it and ring portion 20c which conforms in shape and size to the inner surface of tubular portion 10e of housing 10 so that when tubular member 20 is inserted into axial opening 10c from the interior of housing 10 the outer portion 20a thereof snaps over and snugly engages tubular portion 10e, and ring portion 20c engages the inner surface of housing end wall 10b to hold the tubular member 20 in place. The housing is shaped at the junction of wall 10b and tubular portion 10e to provide a circular opening for an O-ring seal 21 which functions to prevent air leakage between housing 10 and tubular member 20. When mounted in place as shown in FIG. 1, the inner portion 20b of tubular member 20 extends a short distance into the interior of filter element 15 coaxially therewith.

The open end of filter element 15, adjacent closed end 10b of the housing 10, is provided with a ring-like end cap 25 which is molded over the ends of the liners 15a, 15b and pleated paper filter 16. End cap 25 is preferably made from an elastomer such as a urethane foam material having a relatively soft, rubber-like consistency so that it is capable of functioning as a seal or gasket material. End cap 25, as shown in FIG. 3, is preferably molded so as to have a radially inwardly facing surface between the end edges thereof, most of which has a diameter slightly smaller than the outer diameter of inner portion 20b of tubular member 20. In the preferred embodiment the inwardly facing surface 25a has a diameter at the outer face 25c of end cap 25 of about the same size as the outer diameter of the tubular member 20 and a gradually reducing diameter toward the inner face 25d of end cap 25 which is less than the outside diameter of member 20. The elastomer material of end cap 25 is thus compressed at the surface 25a to provide a positive clean air seal between the end cap 25 and the outlet member 20. As also shown in FIG. 3, the innermost end of portion 20b is formed to have a slightly smaller diameter so that end cap 25 can easily be inserted over portion 20b. End cap 25 thus has a generally cylindrical inner sur-

face 25a of gradually reducing diameter from outside to inside constructed and arranged to fit over and sealingly engage the inner portion 20b of outlet member 20 to thus provide a positive air seal between the end cap 25 and inner portion 20b of outlet member 20.

End cap 25 is also provided with a plurality of axially outwardly extending, arcuate projections or protrusions 25b which engage end wall 10b to hold the filter element in place. The relationship between end cap 25 and tubular outlet member 20 maintains filter element 15 in a coaxial relationship with housing 10 at the outlet end of the air cleaner.

The distance between closed end 10b of housing 10 and cover 11 is such as to lightly compress the projections or protrusions 17a, 25b to minimize or dampen axial movements of filter element 15 in the housing 10.

With the air cleaner assembled as shown in FIG. 1, the engine draws air through the filter assembly from housing inlet 14 into a distribution chamber 26 formed between outer wall 10a and outer liner 15b. The contaminated incoming air is thus distributed generally evenly over the outer surface of filter element 15 and is drawn through the pleated paper filter 16 into the interior of filter element 15 for discharge through outlet opening 10c. All of the foreign material carried by the incoming air is thus deposited on the pleated paper filter 16. It is important that all of the incoming air be passed through the filter, because if the dirty incoming air is permitted to escape around the filter, the engine may be damaged. The dirty air cannot escape around the filter at the closed end because that end is completely covered by cap 17. At the air outlet end of the housing, however, it is necessary to provide a seal between the filter element 15 and the housing 10 to prevent leakage therebetween. In the present case, that seal is provided by the tight engagement of inner peripheral wall 25a of end cap 25 with the outer peripheral wall of portion 20b of tubular outlet member 20. This sealing relationship is enhanced by the pressure differential between the inlet and outlet of the air cleaner during operation of the system. Because a positive clean air seal is achieved as just described, there is no need to clamp the filter element 15 tightly against the end wall 10b. Thus, no expensive clamping devices are required, and only light pressure against the ends of the filter element need be maintained to minimize movement within the housing. In the preferred embodiment as shown in the drawings, the housing 10 is constructed from a commodity grade plastic material. Such a material would ordinarily not be strong enough to provide the axial compression sealing required by the prior art techniques. With the present sealing technique, however, such

strength is not required, so that a lesser material can be used for the housing. In the embodiment of the invention shown in the drawings, a standard filter element has been shown because that construction is available. The standard filter element 15 uses relatively heavy perforated metal liners 15a, 15b in order to withstand the standard compression sealing techniques. However, it should be understood that the structure of the filter element might also be modified as development of this invention progresses because the same strength and rigidity is not required using the new sealing technique. The filter element must be strong enough to withstand the pressures caused by air flow therethrough, but it is no longer necessary to withstand the axial compression forces.

#### Claims

1. An air filter arrangement comprising:
  - a housing (10) having first and second opposite ends and a sidewall with an air inlet opening (14) therein; an air outlet member (20) including an inner portion sized for receipt within said housing second end; an air filter element (15) adapted to be operably received within said housing (10) and to be mounted in air flow communication with said air outlet member (20);
  - said air filter element (15) including:
    - a filter (16) defining an open, tubular filter interior; and
    - a support positioned within said open, tubular filter interior;
  - the outlet member being positionable so that the inner portion thereof extends into the open, tubular filter interior;
  - the outlet member inner portion having an outer surface and an inner surface;
  - the filter (16) having first and second opposite ends; the air filter arrangement including a **first end cap (17)** for preventing flow of unfiltered air into said filter first end, and a **second end cap (25)**;
  - said second end cap (25) enclosing said filter second end;
  - said second end cap (25) **consisting of elastomer material** and having a central aperture therethrough, providing air flow communication with the open filter interior; said filter element being oriented within said housing (10) such that air, during filtering, is directed through said filter element (15) in a direction toward said inner support; the arrangement being characterized in that
    - (a) it includes a sealing arrangement lining said second end cap central aperture;
    - said sealing arrangement including a seal-

- ing portion (25a) of the second end cap (25);  
 said sealing portion (25a) **consisting of** soft, compressible, elastomer material positioned within the filter open, tubular, interior and adjacent the support (15a) on an opposite side thereof from the filter (16), said sealing portion (25a) being compressed, within the open filter interior, between the support in the open, tubular filter interior and the outer surface of the inner portion of the outlet member (20), when the outlet member (20) is positioned with the inner portion thereof extended into the open, tubular filter interior;  
 said sealing portion (25a) being sized, relative to said air outlet member (20), to form a radial seal with said outlet member (20) when said air filter element (15) is mounted on said air outlet member (20); and  
 (b) the outlet member inner surface defines an inner wall of an air outlet passage from the filter interior.
2. An arrangement according to claim 1, wherein
    - (a) the support positioned within said open, tubular filter interior is an inner filter support which lines the filter.
  3. An arrangement according to claim 2, wherein
    - (a) said open, tubular filter interior is cylindrical; and
    - (b) the second end cap (25) comprises soft elastomer material.
  4. An air filter arrangement according to claim 3, wherein said sealing portion (25a) comprises urethane foam.
  5. An air filter arrangement according to claim 3, wherein said sealing portion (25a) defines a circular air outlet of decreasing diameter in extension toward said open filter interior.
  6. An arrangement according to claim 3, wherein said outlet member (20) comprises a member axially movable, relative to said housing (10).
  7. An arrangement according to claim 3, wherein said housing (10) comprises lightweight plastic.
  8. An arrangement according to claim 3, wherein said housing **first end** includes an openable cover (11) thereon.
  9. An arrangement according to claim 3, wherein said housing (10) has a longitudinal axis with first and second ends; and a distance between said housing first and second ends is such as to lightly compress said filter element (15) therebetween, without establishing a fluid seal between said housing first end and said filter element (15).
  10. An arrangement according to claim 9, wherein said filter first end cap (17) includes a plurality of axial projections (17a) thereon, for engagement with said housing first end.
  11. An air filter arrangement according to claim 3, wherein said outlet member (20) is structurally independent of said housing (10).
  12. An arrangement according to claim 2, wherein said housing (10) comprises a commodity grade plastic material.
  13. An arrangement according to claim 2, wherein said outlet member (20) is separable from, and engages, a remainder of said housing (10).
  14. An arrangement according to claim 2, wherein said outlet member (20) includes means for engagement with a remainder of said housing (10).
  15. An arrangement according to claim 2, wherein **said first end of** said housing (10) is selectively openable, for access to said filter element (15).
  16. An arrangement according to claim 15, wherein said housing **second end** is a closed end with an axial outlet opening (10c).
  17. An arrangement according to claim 15, wherein said **first end of** said housing (10) is selectively openable, for access to said filter element (15), without dismounting said filter element (15) from said outlet member (20).
  18. An arrangement according to claim 2, wherein said closed end of said filter element (15) is closed by **said second end cap** (25) having a soft, rubber-like consistency.
  19. An arrangement according to claim 2, wherein said filter element comprises a cylindrical pleated paper filter (16) positioned between two cylindrical, perforated metal liners.

20. An arrangement according to claim 2, wherein said second end cap (25) is in a ring-like shape and has an outer surface with at least one outwardly extending axial projection thereon, for engagement with said housing (10).

#### Patentansprüche

1. Luftfilteranordnung mit:  
 einem Gehäuse (10), das erste und zweite einander entgegengesetzte Enden sowie eine Seitenwandung mit darin angeordneter Lufteinlaßöffnung (14) aufweist;  
 einem Luftauslaß (20) einschließlich eines inneren Bereichs, dessen Abmessung zur Aufnahme innerhalb des zweiten Endes des Gehäuses ausgelegt ist;  
 einem Luftfilterelement (15), das zur Aufnahme innerhalb des Gehäuses (10) ausgelegt und in Luftströmungsverbindung mit dem Luftauslaß (20) befestigt ist;  
 wobei dieses Luftfilterelement (15) folgendes aufweist: ein Filter (16), das einen offenen, röhrenförmigen Filterinnenbereich enthält sowie eine innerhalb dieses offenen, röhrenförmigen Filterinnenbereichs angeordnete Auflage aufweist;  
 dabei ist der Auslaß derart positionierbar, daß dessen Innenbereich sich in den offenen, röhrenförmigen Filterinnenbereich erstreckt;  
 wobei der Innenbereich des Auslasses eine Außenoberfläche und eine Innenoberfläche und das Filter (16) erste und zweite einander entgegengesetzte Enden hat;  
 wobei ferner die Luftfilteranordnung eine erste Endkappe (17) zur Zuflußverhinderung ungefilterter Luft in dieses erste Filterende sowie eine zweite Endkappe (25) enthält, die das zweite Filterende umschließt, aus Elastomermaterial besteht und eine zentrale Durchgangsöffnung aufweist zur Herstellung einer Luftstromverbindung mit dem offenen Filterinnenbereich;  
 wobei dieses Filterelement innerhalb des Gehäuses (10) derart ausgerichtet ist, daß während des Filtervorgangs Luft durch dieses Filterelement (15) in Richtung auf das innere Auflager geleitet wird;  
 diese Anordnung ist **dadurch gekennzeichnet**, daß  
 (a) sie eine Abdichtanordnung enthält, die diese zentrale Öffnung der zweiten Endkappe auskleidet;  
 die Abdichtanordnung einen Abdichtbereich (25a) der zweiten Endkappe (25) enthält;  
 dieser Abdichtbereich (25a) aus weichem, kompressiblem Elastomermaterial besteht, das im offenen, röhrenförmigen Filterinnen-

bereich und angrenzend an das Auflager (15a) an dem gegenüberliegenden Ende des Filters (16) angeordnet ist und dieser Abdichtbereich (25a) innerhalb des offenen Filterinnenbereichs zwischen dem Auflager im offenen, röhrenförmigen Filterinnenbereich und der Außenoberfläche des inneren Bereichs des Auslasses (20) zusammengedrückt wird, wenn der Auslaß (20) so positioniert ist, daß dessen innerer Bereich sich in den offenen, röhrenförmigen Filterinnenbereich erstreckt;  
 wobei dieser Abdichtbereich (25a) hinsichtlich dieses Luftauslasses (20) so bemessen ist, daß mit diesem Auslaß (20) eine radiale Dichtung ausgebildet wird, wenn dieses Luftfilterelement (15) auf diesem Luftauslaß (20) befestigt ist; und  
 (b) die Innenoberfläche des Auslasses eine innere Wandung eines Luftausgangsdurchlasses des Filterinnenbereichs bildet.

2. Anordnung nach Anspruch 1, **dadurch gekennzeichnet**, daß  
 (a) das innerhalb des offenen, röhrenförmigen Filterinnenbereichs angeordnete Auflager ein inneres Filterauflager ist, welches das Filter auskleidet.
3. Anordnung nach Anspruch 2, **dadurch gekennzeichnet**, daß  
 (a) dieser offene, röhrenförmige Filterinnenbereich zylinderförmig ist; und  
 (b) die zweite Endkappe (25) weiches Elastomermaterial enthält.
4. Luftfilteranordnung nach Anspruch 3, **dadurch gekennzeichnet**, daß der Abdichtbereich (25a) Urethanschäum enthält.
5. Luftfilteranordnung nach Anspruch 3, **dadurch gekennzeichnet**, daß der Abdichtbereich (25a) einen kreisförmigen Luftauslaß bildet, dessen Durchmesser sich in Richtung auf diesen offenen Filterinnenbereich verringert.
6. Anordnung nach Anspruch 3, **dadurch gekennzeichnet**, daß der Auslaß (20) ein relativ zum Gehäuse (10) axial bewegliches Teil umfaßt.
7. Anordnung nach Anspruch 3, **dadurch gekennzeichnet**, daß das Gehäuse (10) Leicht-Plastik enthält.
8. Anordnung nach Anspruch 3, **dadurch gekennzeichnet**, daß das erste

Ende des Gehäuses einen abnehmbaren Deckel (11) enthält.

9. Anordnung nach Anspruch 3,  
dadurch gekennzeichnet, daß das Gehäuse (10) eine Längsachse mit ersten und zweiten Enden aufweist, wobei der Abstand zwischen dem ersten und zweiten Ende des Gehäuses so gewählt ist, daß dieses Filterelement (15) leicht dazwischen zusammengedrückt wird, ohne dabei eine Fluidichtung zwischen dem ersten Ende des Gehäuses und dem Filterelement (15) herzustellen.

10. Anordnung nach Anspruch 9,  
dadurch gekennzeichnet, daß die erste Endkappe (17) des Filters eine Vielzahl axialer Vorsprünge (17a) enthält zum Ineingriffkommen mit dem ersten Ende des Gehäuses.

11. Luftfilteranordnung nach Anspruch 3,  
dadurch gekennzeichnet, daß der Auslaß (20) von dem Gehäuse (10) strukturell unabhängig ist.

12. Anordnung nach Anspruch 2,  
dadurch gekennzeichnet, daß das Gehäuse (10) handelsübliches Kunststoffmaterial enthält.

13. Anordnung nach Anspruch 2,  
dadurch gekennzeichnet, daß der Auslaß (20) in einen Restbereich des Gehäuses (10) eingreift und auch von diesem trennbar ist.

14. Anordnung nach Anspruch 2,  
dadurch gekennzeichnet, daß der Auslaß (20) Mittel enthält zum Ineingrifftreten mit dem Rest des Gehäuses (10).

15. Anordnung nach Anspruch 2,  
dadurch gekennzeichnet, daß diese erste Ende des Gehäuses (10) für den Zugriff auf dieses Filterelement (15) selektiv abnehmbar ausgebildet ist.

16. Anordnung nach Anspruch 15,  
dadurch gekennzeichnet, daß das zweite Ende des Gehäuses ein geschlossenes Ende ist mit einer axialen Auslaßöffnung (10c).

17. Anordnung nach Anspruch 15,  
dadurch gekennzeichnet, daß das erste Ende des Gehäuses (10) für einen Zugriff auf dieses Filterelement (15) selektiv lösbar ist, ohne dieses Filterelement (15) von diesem Einlaß (20) abmontieren zu müssen.

18. Anordnung nach Anspruch 2,  
dadurch gekennzeichnet, daß das geschlossene Ende dieses Filterelements (15) von der zweiten Endkappe (25) geschlossen wird, die eine weiche und gummiähnliche Konsistenz aufweist.

19. Anordnung nach Anspruch 2,  
dadurch gekennzeichnet, daß das Filterelement einen zylinderförmigen Filter (16) aus gefaltetem Papier enthält, der zwischen zwei zylindrischen, perforierten Metallauskleidungen angeordnet ist.

20. Anordnung nach Anspruch 2,  
dadurch gekennzeichnet, daß diese zweite Endkappe (25) ringförmig ausgebildet ist und an der nach außen gerichteten Oberfläche mindestens einen nach außen gerichteten axialen Vorsprung enthält zum Ineingriffkommen mit dem Gehäuse (10).

#### Revendications

1. Filtre à air comprenant :  
un boîtier (10) comprenant une première et une seconde extrémités opposées et une paroi latérale comprenant une ouverture d'entrée d'air (14) ; un élément d'évacuation d'air (20) comprenant une portion intérieure d'une taille telle qu'il peut être placé dans ladite seconde extrémité du boîtier ; un élément de filtrage d'air (15) pouvant être placé à l'intérieur dudit boîtier (10) et monté de façon à permettre le passage d'un flux d'air vers ledit élément d'évacuation d'air (20) ;  
ledit élément de filtrage d'air (15) comprenant :  
un filtre (16) présentant un intérieur de filtre tubulaire ouvert ; et  
un support placé dans dudit intérieur de filtre tubulaire ouvert ;  
l'élément d'évacuation d'air pouvant être placé de façon que sa portion intérieure se prolonge à l'intérieur dudit intérieur de filtre tubulaire ouvert ;  
la portion intérieure de l'élément d'évacuation d'air comprenant une surface intérieure et une surface extérieure ;  
le filtre (16) comprenant une première et une seconde extrémités opposées ;  
le filtre à air comprenant un premier bouchon (17) pour empêcher le passage d'un flux d'air non filtré à l'intérieur de la première extrémité dudit filtre, et un second bouchon (25) ;  
ledit second bouchon (25) étant composé d'un matériau élastomère et comportant un orifice central permettant le passage d'un flux d'air vers ledit filtre intérieur ouvert ;

- ledit élément de filtrage étant orienté à l'intérieur dudit boîtier (10) de façon telle que l'air, pendant le filtrage, soit dirigé à travers ledit élément de filtrage (15) en direction dudit support intérieur ;
- ledit dispositif étant caractérisé en ce que
- (a) il comprend un dispositif d'étanchéité entourant ledit second bouchon de l'orifice central ;
  - ledit dispositif d'étanchéité comprenant une portion d'étanchéité (25a) du second bouchon (25) ;
  - ladite portion d'étanchéité étant formée par un matériau souple, compressible, élastomère placé dans l'intérieur de filtre tubulaire ouvert, et étant adjacente au support (15a) sur une face opposée au filtre (16), ladite portion d'étanchéité étant comprimée, dans ledit intérieur de filtre ouvert, entre un support dans ledit intérieur tubulaire et la surface extérieure de la portion intérieure de l'élément d'évacuation d'air (20), quand ledit élément d'évacuation d'air (20) est placé de façon que la portion intérieure de l'élément d'évacuation d'air (20) se prolonge dans le intérieur de filtre tubulaire ouvert ;
  - la taille de ladite portion d'étanchéité (25a) étant prévue pour former, par rapport audit élément d'évacuation d'air (20), un joint d'étanchéité radial avec ledit élément d'évacuation d'air (20) quand ledit élément de filtrage d'air (15) est monté sur ledit élément d'évacuation d'air (20) ; et
  - (b) la surface intérieure de l'élément d'évacuation d'air définit une paroi intérieure d'un passage d'évacuation d'air à partir du filtre intérieur.
2. Filtre à air selon la revendication 1, caractérisé en ce que le support placé dans ledit intérieur de filtre tubulaire ouvert est un support intérieur de filtre qui entoure le filtre.
  3. Filtre à air selon la revendication 2, caractérisé en ce que
    - (a) ledit intérieur de filtre tubulaire ouvert est cylindrique ; et
    - (b) le second bouchon (25) comprend un matériau élastomère souple.
  4. Filtre à air selon la revendication 3, caractérisé en ce que ladite portion d'étanchéité comprend une mousse en uréthane.
  5. Filtre à air selon la revendication 3, caractérisé en ce que ladite portion d'étanchéité (25) définit une évacuation d'air circulaire de diamètre décroissant vers ledit intérieur de filtre ouvert.
  6. Filtre à air selon la revendication 3, caractérisé en ce que ledit élément d'évacuation d'air (20) comprend un élément pouvant être déplacé axialement par rapport audit boîtier (10).
  7. Filtre à air selon la revendication 3, caractérisé en ce que ledit boîtier (10) comprend du plastique léger.
  8. Filtre à air selon la revendication 3, caractérisé en ce que la première extrémité dudit boîtier est recouvert d'un bouchon amovible (11).
  9. Filtre à air selon la revendication 3, caractérisé en ce que les première et seconde extrémités dudit boîtier (10) forment un axe longitudinal ; et une distance est prévue entre lesdites première et seconde extrémités du boîtier pour légèrement comprimer ledit élément de filtrage (15), sans établir d'étanchéité au fluide entre ladite première extrémité du boîtier et ledit élément de filtrage (15).
  10. Filtre à air selon la revendication 9, caractérisé en ce que le premier bouchon (17) présente une pluralité de projections axiales (17a), pour le solidariser avec ladite première extrémité du boîtier.
  11. Filtre à air selon la revendication 3, caractérisé en ce que ledit élément d'évacuation d'air (20) est conçu de façon à être indépendant dudit boîtier (10).
  12. Filtre à air selon la revendication 2, caractérisé en ce que ledit boîtier (10) comprend une matière première plastique.
  13. Filtre à air selon la revendication 2, caractérisé en ce que ledit élément d'évacuation d'air (20) peut soit être séparé de, soit solidariser avec un col dudit boîtier (10).
  14. Filtre à air selon la revendication 2, caractérisé en ce que ledit élément d'évacuation d'air (20) comprend des moyens destinés à le solidariser avec ledit boîtier (10).
  15. Filtre à air selon la revendication 2, caractérisé en ce que ladite première extrémité dudit boîtier (10) peut être ouverte, pour permettre l'accès audit élément de filtrage (15).
  16. Filtre à air selon la revendication 15, caractérisé en ce que ladite seconde extrémité dudit boîtier est une extrémité fermée avec une ouverture axiale d'évacuation d'air (10c).



17. Filtre à air selon la revendication 15, caractérisé en ce que ladite première extrémité dudit boîtier (10) peut être ouverte, afin de permettre l'accès audit élément de filtrage (15), sans désolidariser ledit élément de filtrage (15) dudit élément d'évacuation d'air (20). 5
18. Filtre à air selon la revendication 2, caractérisé en ce que ladite extrémité fermée dudit élément de filtrage (15) est fermée par ledit second bouchon (25) ayant une consistance souple, telle que du caoutchouc. 10
19. Filtre à air selon la revendication 2, caractérisé en ce que ledit élément de filtrage comprend un filtre en papier, plissé et cylindrique (16) placé entre deux cales en métal, perforées et cylindriques. 15
20. Filtre à air selon la revendication 2, caractérisé en ce que ledit second bouchon (25) a une forme de bague et a une surface extérieure comprenant au moins une projection s'étendant axialement vers l'extérieur, afin de permettre la solidarisation avec ledit boîtier (10). 20 25

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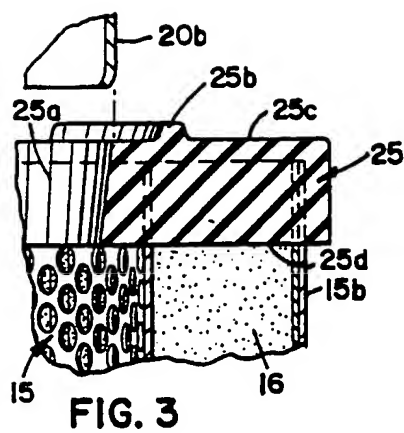


FIG. 2

